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(54) **Separation device for a vacuum cleaner**

Trennvorrichtung für Staubsauger

Dispositif de séparation pour aspirateur

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US-A- 5 350 432 US-A- 5 525 396**

• **PATENT ABSTRACTS OF JAPAN vol. 017, no.
452 (C-1099), 19 August 1993 & JP 05 104033 A
(DAIHEN CORP), 27 April 1993,**

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Description

[0001] The present invention relates to a vacuum cleaner arrangement comprising a vacuum source communicating with a tube handle, said tube handle being connected to a nozzle by means of a tube shaft and a cyclone separator.

[0002] Vacuum cleaners of the general type mentioned above, so-called canister vacuum cleaners, are previously known. These vacuum cleaners comprise a vacuum cleaner housing having a vacuum source, usually a fan unit, and a dust container or bag. The dust particles entrained in the air drawn through the nozzle flow through the tube shaft, the tube handle and the hose into the airpermeable dust bag in which the particles are collected before the filtered air flows further through the fan unit to atmosphere.

[0003] It is previously known to use separating devices for canister-type vacuum cleaners in order to separate larger dirt particles before they reach the dust container. Such a device is described in DE-A-2946572. This publication shows a canister-type vacuum cleaner in which the cyclone separator is placed directly on the vacuum cleaner housing. The outlet of the separator communicates with the dust container, whereas the vacuum cleaner hose is connected to the separator. However, the position of the separator has certain disadvantages since it increases the total height of the vacuum cleaner housing, which means that tensioning forces, which always are present in the hose when the vacuum cleaner housing is moved on the floor, are applied to the vacuum cleaner at a high level and, hence, cause undesirable turning moments on the separation device and on the vacuum cleaner. Thus, the fastening means of the separation device has to be designed to resist these moments and forces. The high position at which the forces are applied also means that the vacuum cleaner has a tendency to tip-over when it is moved sideways.

[0004] It is also previously known to use cyclone separators in so-called upright vacuum cleaners. See, for instance, EP-A-489565. Upright vacuum cleaners are, however, designed quite differently than canister cleaners since the nozzle and the vacuum cleaner housing is one single non-separable unit in which also the cyclone separator is placed.

[0005] U.S. Patent No. 5,350,432 further describes a canister-type vacuum cleaner having a tube shaft in which the air is circulated during its upward movement within the shaft. The circulating flow is created by means of an element provided with inclined vanes that is placed within the tube shaft. A dirt collecting chamber communicating with the tube shaft by means of a small opening with a cut piece is placed at the upper end of the shaft. The '432 arrangement is complicated and, since the tube shaft is mainly directed upwards, during handling there is a risk that particles which have been sucked into the tube shaft are not lifted up to the open-

ing to the collecting chamber but rather fall backwards within the shaft.

[0006] Suction cleaning devices provided with cyclones for picking up oily swarf from cutting and milling operations are also previously known, see GB-A-2035787, but such devices are unsuitable for ordinary vacuum cleaning purposes.

[0007] Cyclone dust collectors are also previously known, see JP-A-5104033, but this type of equipment is neither designed for ordinary vacuum cleaning operations.

[0008] The present invention provides a simple and effective cyclone separator for a vacuum cleaner of the canister type in which the separator is placed such that the aforementioned drawbacks are minimized or eliminated.

[0009] This is achieved by an arrangement as defined in independent claims 1 and 2.

[0010] The dependant claim defines a particular embodiment of the vacuum cleaner defined in the independent claims.

[0011] These and further features of the invention will be apparent with reference to the following description and drawings, wherein:

FIG. 1 schematically shows a vacuum cleaner with a separation device according to the invention;

FIG. 2 is a vertical section through the separation device;

FIG. 3 is a section in somewhat larger scale on the line III-III in FIG. 2; whereas

FIG. 4 is a vertical section through an alternative embodiment of a device according to the invention.

[0012] With reference to FIG. 1, a vacuum cleaner according to the present invention has a housing 10 enclosing a motor-fan unit 11 and a dust container 12, preferably a dust bag of airpermeable material. The housing is, by means of a hose 13, connected to a tube handle 14 which is connected to the upper part of a tube shaft 15. The lower part of the tube shaft 15 is connected to a conventional vacuum cleaner nozzle 16.

[0013] With reference to FIGS. 2 and 3, the tube shaft 15 comprises an outer tube-shaped part 17 and a liner 18. The liner 18 is spaced a distance from the outer part 17 so that a first, mainly circular channel 19 is defined between the liner and the outer part 17. The channel 19 is also limited by an upper and a lower partition wall 20 and 21 respectively.

[0014] The liner 18 comprises an upper, mainly cylindrical part 18a and a lower part 18b which is shaped as an up-side-down truncated cone with a downwardly-directed opening 22. The upper part 18a of the liner 18 has an inlet opening 23 to a whirl chamber 24 formed by the liner. The inlet opening 23 is connected to the first channel 19 via a curved wall portion 25, giving the air flowing into the whirl chamber 24 a mainly tangentially-directed movement.

[0015] The opening 22 is placed above a collecting chamber 26 which is formed by a bottom part 27 of the tube-shaped part 17. The bottom part 27 can be removed from the tube-shaped part 17 in order to empty the chamber 26.

[0016] The first channel 19 is, by means of a second channel 28, connected to the inlet of the tube shaft which is connected to the nozzle 16.

[0017] The upper partition wall 20 continues radially inwardly into a wall portion 29 which partially covers the liner 18. The wall portion 29 has a central opening 30 from which a sleeve 31 extends downwardly into the whirl chamber 24. The opening 30 communicates with an upper connecting tube 32 to which the tube handle 14 is connected.

[0018] The device operates in the following way. Dust and dirt-particle laden air is drawn into the nozzle 16 by the fan unit 11 and flows through the channel 28, the channel 19, and through the opening 23 tangentially into the whirl chamber 24. Due to centrifugal force, dust particles are thrown outwardly toward the inner peripheral wall of the liner 18 and, due to gravity, simultaneously fall gradually downwardly through the opening 22 and are collected in the chamber 26. The partially-cleaned air flows out of the whirl chamber 24 via the sleeve 31 then upwardly through the connecting tube 32, the tube handle 14, and the hose 13 into the dust container 12. The finer particles are separated in the dust container 12 before the air flows through the fan unit 11 to atmosphere.

[0019] In an alternative embodiment shown in FIG. 4, a conventional tube shaft 33 is used. A shell 34 is disposed between the tube shaft 33 and the tube handle 14. The shell 34 is connected to the tube shaft 33 via a first tube coupling 35 and to the tube handle 14 via a second tube coupling 40.

[0020] The shell 34 comprises an upper part 34a and a lower part 34b. The upper part 34a encloses a channel 36 that communicates with the first tube coupling 35. The channel 36 also communicates with a whirl chamber 37, which is a part of a cyclone separator, and which is partially limited by a mainly cylindrically-shaped wall part, as illustrated. The cylindrically-shaped wall part has an opening 38 designed and positioned such that the air flows tangentially into the whirl chamber 37 from the channel 36.

[0021] The whirl chamber 37 comprises an outlet tube 39 continuing into the second tube coupling 40 to which the tube handle 14 is connected. The outlet tube 39 is placed near, or at, a center of the whirl chamber such that an axis of the outlet tube 39 is mainly parallel to an axis of the whirl chamber 37.

[0022] The lower part 34b of the shell 34 encloses a liner 41 which is shaped as an up-side-down truncated cone with a lower opening 42. The whirl chamber 37 communicates with a collecting container 43 via the opening 42. Separated particles fall through the opening 42 and are collected in the container 43. The collect-

ing container 43 has, at its bottom, an emptying opening which is normally closed by a cover 44.

[0023] In the alternative embodiment shown in FIG. 4, dust and dirt-particle laden air is drawn in through the tube shaft 33, the channel 36, and the opening 38, and is introduced tangentially into the whirl chamber 37. The air rotates within the whirl chamber 37, causing dirt particles to be thrown outwardly toward the periphery. Simultaneously, the dirt particles fall downwardly through the opening 42 and are collected at the bottom of the container 43. The partially cleaned air flows from the whirl chamber 37 through the outlet tube 39, the second tube coupling 40, and into the tube handle 14. The air continues through the tube handle 14 and the hose 13 to the dust bag 12 arranged within the vacuum cleaner housing 10. Filtered air from the dust bag 12 exits to atmosphere via the fan unit 11 (FIG. 1).

[0024] It should be mentioned that the invention also can be used for the type of vacuum cleaners which have been developed during recent years and where the tube handle is a hand-held unit comprising a dust bag as well as the fan unit and which is connected to a tube shaft with a nozzle.

Claims

1. A vacuum cleaner arrangement comprising a vacuum source (11) communicating with a tube handle (14), said tube handle being connected to a nozzle (16) by means of a tube shaft (33) and a cyclone separator, characterized in that said cyclone separator has a whirl chamber (37) which comprises an up-side-down truncated cone (41) and a mainly cylindrical wall part and that said separator further comprises;

an inlet opening (38), said inlet opening being located at an upper part of the whirl chamber (37) such that the air flows mainly tangentially into the whirl chamber;

a central first outlet opening (39) for partially cleaned air, said first outlet opening communicating with the vacuum source;

a second outlet opening (42) for separated particles disposed at a lower part of the whirl chamber, said second outlet opening communicating with a dust collecting container (43);

said cyclone separator being enclosed in a shell (34) comprising a first tube coupling (35) and a second tube coupling (40), said first tube coupling being connected to the tube shaft (33) and said second tube coupling (40) being connected to the tube handle (14);

said shell (34) having a channel (36) connecting said first tube coupling (35) to said whirl chamber (37);

said first outlet opening (39) being shaped as a sleeve having an axis which is generally paral-

lel to the axis of the cylindrical wall part, said sleeve being connected to the second tube coupling (40).

2. A vacuum cleaner arrangement comprising a vacuum source (11) communicating with a tube handle (14), said tube handle being connected to a nozzle (16) by means of a tube shaft (15) provided with a cyclone separator, **characterized in that** said cyclone separator has a whirl chamber (24) which comprises an up-side-down truncated cone (18b) and a mainly cylindrical wall part and said separator further comprises;

an inlet opening (23), said inlet opening being located at an upper part of the whirl chamber (24) such that the air flows mainly tangentially into the whirl chamber;

a central first outlet opening (31) for partially cleaned air, said first outlet opening communicating with the vacuum source;

a second outlet opening (22) for separated particles disposed at a lower part of the whirl chamber, said second outlet opening communicating with a dust collecting container (26); said inlet opening (23) communicating with a connecting tube disposed at the lower part of the tube shaft via a channel (19);

said first outlet opening (31) being shaped as a sleeve having an axis which is generally parallel to an axis of the cylindrical wall part, said sleeve communicating with a tube connection (32) for the tube handle (14).

3. Vacuum cleaner arrangement according to any of the preceding claims, **characterized in that** the tube handle (14) is connected to the vacuum source via a hose (13).

Patentansprüche

1. Staubsaugervorrichtung, umfassend eine Saugluftquelle (11), welche mit einem rohrförmigen Handstück (14) in Verbindung steht, wobei das rohrförmige Handstück über einen rohrförmigen Schaft (33) und einen Wirbelabscheider mit einer Düse (16) verbunden ist, **dadurch gekennzeichnet, daß** der Wirbelabscheider eine Wirbelkammer (37) besitzt, welche einen sich von oben nach unten verengenden Konus (41) und einen im wesentlichen zylindrischen Wandabschnitt aufweist, und daß der Abscheider weiterhin umfaßt:

eine Einlaßöffnung (38), welche in einem oberen Bereich der Wirbelkammer (37) so angeordnet ist, daß der Luftstrom im wesentlichen tangential in die Wirbelkammer eintritt;
eine zentrale erste Auslaßöffnung (39) für teilweise gereinigte Luft, wobei die erste Auslaßöffnung mit der Saugluftquelle verbunden ist;

weise gereinigte Luft, wobei die erste Auslaßöffnung mit der Saugluftquelle verbunden ist;

eine zweite Auslaßöffnung (42) für abgeschiedene Partikel, welche in einem unteren Bereich der Wirbelkammer angeordnet ist, wobei die zweite Auslaßöffnung mit einem Staubsammelbehälter (43) verbunden ist;

wobei der Wirbelabscheider von einem Gehäuse (34) umschlossen ist, welches eine erste Rohrkupplung (35) und eine zweite Rohrkupplung (40) umfaßt, wobei die erste Rohrkupplung mit dem rohrförmigen Schaft (33) und die zweite Rohrkupplung (40) mit dem rohrförmigen Handstück (14) verbunden ist;

wobei das Gehäuse (34) einen Kanal (36) besitzt, welcher die erste Rohrkupplung (35) mit der Wirbelkammer (37) verbindet;

wobei die erste Auslaßöffnung (39) als Hülse geformt ist, welche eine Achse besitzt, die im wesentlichen parallel zur Achse des zylindrischen Wandabschnittes verläuft, wobei die Hülse mit der zweiten Rohrkupplung (40) verbunden ist.

2. Staubsaugervorrichtung, umfassend eine Saugluftquelle (11), welche mit einem rohrförmigen Handstück (14) in Verbindung steht, wobei das rohrförmige Handstück über einen rohrförmigen Schaft (15), welcher mit einem Wirbelabscheider versehen ist, mit einer Düse (16) verbunden ist, **dadurch gekennzeichnet, daß** der Wirbelabscheider eine Wirbelkammer (24) besitzt, welche einen sich von oben nach unten verengenden Konus (18b) und einen im wesentlichen zylindrischen Wandabschnitt aufweist, und daß der Abscheider weiterhin umfaßt:

eine Einlaßöffnung (23), welche in einem oberen Bereich der Wirbelkammer (24) so angeordnet ist, daß die Luft im wesentlichen tangential in die Wirbelkammer strömt;

eine zentrale erste Auslaßöffnung (31) für teilweise gereinigte Luft, wobei die erste Auslaßöffnung mit der Saugluftquelle verbunden ist;

eine zweite Auslaßöffnung (22) für abgeschiedene Partikel, welche in einem unteren Bereich der Wirbelkammer angeordnet ist, wobei die zweite Auslaßöffnung mit einem Staubsammelbehälter (26) verbunden ist;

wobei die Einlaßöffnung (23) über einen Kanal (19) mit einem Verbindungsrohr, welches im unteren Bereich des rohrförmigen Schaftes angeordnet ist, verbunden ist;

wobei die erste Auslaßöffnung (31) als eine Hülse ausgebildet ist, welche eine Achse besitzt, die im wesentlichen parallel zu einer Achse des zylindrischen Wandbereiches verläuft, und die Hülse mit einem Rohrverbinder

(32) des rohrförmigen Handstückes (14) verbunden ist.

3. Staubsaugervorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß das rohrförmige Handstück (14) mit der Saugluftquelle über einen Schlauch (13) verbunden ist.**

Revendications

1. Agencement d'aspirateur comprenant une source de vide (11) communiquant avec un manche tubulaire (14), ledit manche tubulaire étant raccordé à une buse (16) au moyen d'une tige tubulaire (33) et un séparateur à cyclone, caractérisé en ce que ledit séparateur de cyclone possède une chambre de tourbillonnement (37) qui comprend un cône tronqué à l'envers (41) et une partie de paroi essentiellement cylindrique et en ce que ledit séparateur comprend en outre :
 - une ouverture d'admission (38), ladite ouverture d'admission étant placée à une partie supérieure de la chambre de tourbillonnement (37), de telle sorte que l'air circule essentiellement tangentiellement dans la chambre de tourbillonnement ;
 - une première ouverture d'évacuation centrale (39) pour l'air en partie nettoyé, ladite première ouverture d'évacuation communiquant avec la source de vide ;
 - une seconde ouverture d'évacuation (42) pour les particules séparées disposée à une partie inférieure de la chambre de tourbillonnement, ladite seconde ouverture d'évacuation communiquant avec un réceptacle collecteur de poussières (43) ;
 - ledit séparateur de cyclone étant inclus dans une coque (34) comprenant un premier accouplement tubulaire (35) et un second accouplement tubulaire (40), ledit premier accouplement tubulaire étant raccordé à la tige tubulaire (33) et ledit second accouplement tubulaire (40) étant raccordé au manche tubulaire (14) ;
 - ladite coque (34) ayant un canal (36) raccordant ledit premier accouplement tubulaire (35) à ladite chambre de tourbillonnement (37) ;
 - ladite première ouverture d'évacuation (39) étant façonnée sous la forme d'un manchon ayant un axe qui est généralement parallèle à l'axe de la partie de paroi cylindrique, ledit manchon étant raccordé au second accouplement tubulaire (40).
2. Agencement d'aspirateur comprenant une source de vide (11) communiquant avec un manche tubulaire (14), ledit manche tubulaire étant raccordé à

une buse (16) au moyen d'une tige tubulaire (15) munie d'un séparateur à cyclone, caractérisé en ce que ledit séparateur à cyclone possède une chambre de tourbillonnement (24) qui comprend un cône tronqué à l'envers (18b) et une partie de paroi essentiellement cylindrique et ledit séparateur comprend en outre :

- une ouverture d'admission (23), ladite ouverture d'admission étant située à une partie supérieure de la chambre de tourbillonnement (24), de telle sorte que l'air circule essentiellement tangentiellement dans la chambre de tourbillonnement ;
 - une première ouverture d'évacuation centrale (31) pour l'air en partie nettoyé, ladite première ouverture d'évacuation communiquant avec la source de vide ;
 - une seconde ouverture d'évacuation (22) pour les particules séparées disposée à une partie inférieure de la chambre de tourbillonnement, ladite seconde ouverture d'évacuation communiquant avec un réceptacle collecteur de poussières (26) ;
 - ladite ouverture d'admission (23) communiquant avec un tube de raccordement disposé à la partie inférieure de la tige tubulaire par l'intermédiaire d'un canal (19) ;
 - ladite première ouverture d'évacuation (31) étant façonnée comme un manchon ayant un axe qui est généralement parallèle à un axe de la partie de paroi cylindrique, ledit manchon communiquant avec un raccord tubulaire (32) pour le manche tubulaire (14).
3. Agencement d'aspirateur selon l'une quelconque des revendications précédentes, caractérisé en ce que le manche tubulaire (14) est raccordé à la source de vide par l'intermédiaire d'un tuyau (13).

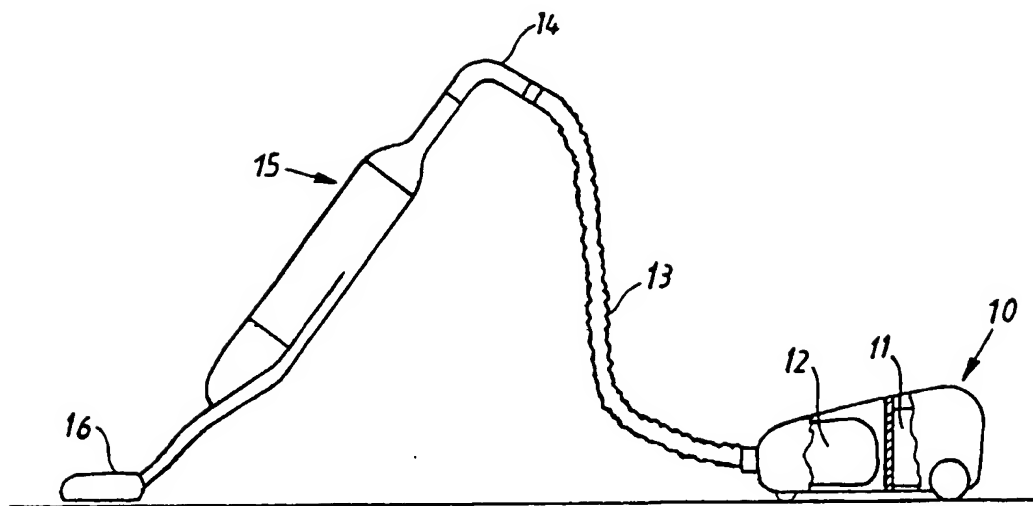


FIG. 1

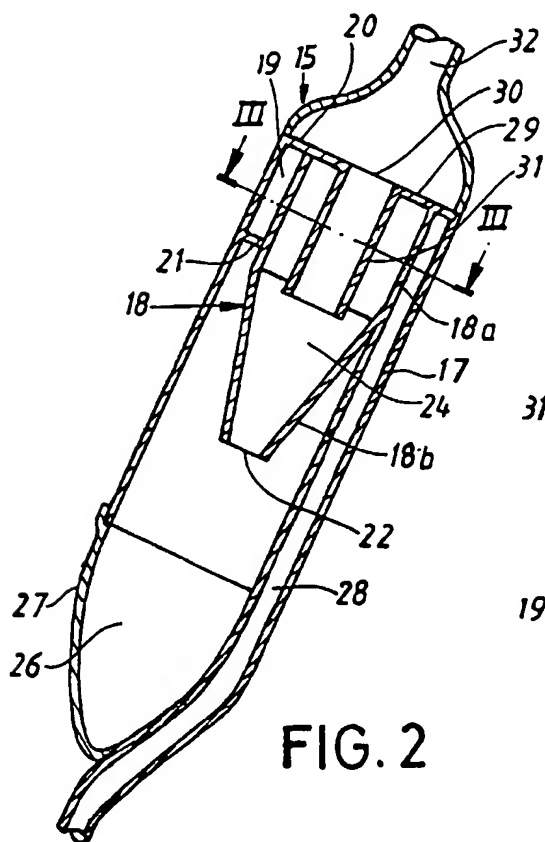


FIG. 2

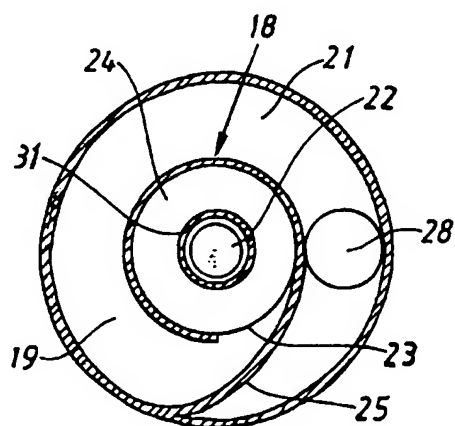


FIG. 3

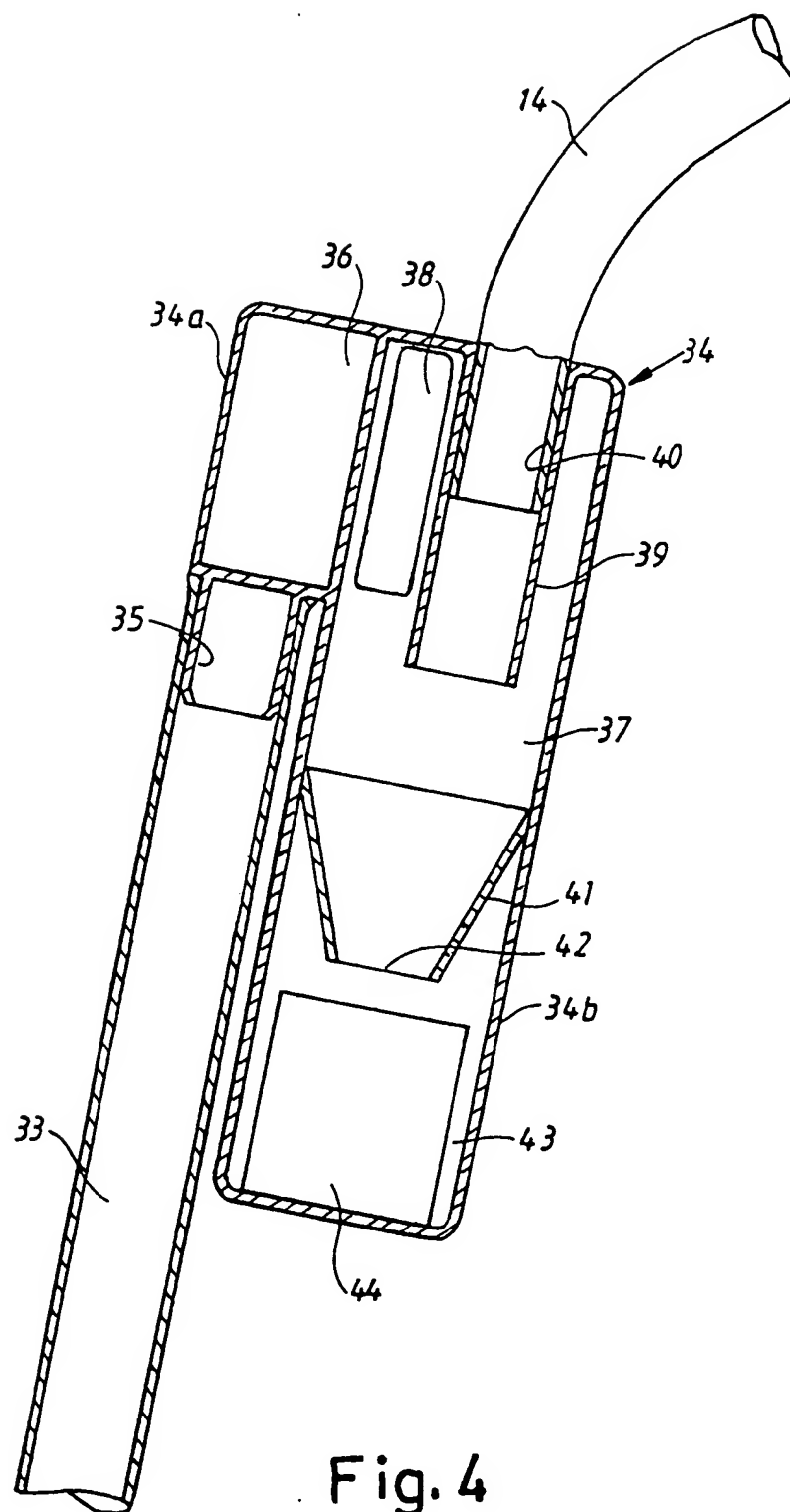


Fig. 4